Dar-Bin Shieh – Deputy Minister of Science and Technology, Republic of China (Taiwan)

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Dar-Bin Shieh, deputy minister of science and technology of the Republic of China (Taiwan), gives an overview of Biomedical Industry Innovation Program, enacted to bolster Taiwan's biomedical and biotechnology sectors as part of the 5+2 Industrial Innovation Plan. Deputy Minister Shieh also elaborates on how Taiwan's unique strengths in ICT, infrastructure, and talent will help drive forward the country's position as a hub of R&D innovation in the Asia Pacific region.

Under President Tsai's 5+2 Industrial Innovation Plan, the Ministry of Science and Technology along with other government agencies have been tasked to carry out the Biomedical Industry Innovation Program. Can you give our readers a brief overview of the initiative and its progress thus far?

The Biomedical Industry Innovation Program (BIIP) is a national initiative to develop Taiwan's biomedical industry. A joint effort by the Ministry of Science and Technology (MOST), the Ministry of Economic Affairs (MOEA), and the Ministry of Health and Welfare (MOHW), the BIIP's mission is to enhance the health and well-being of the people of Taiwan and the world, while transforming Taiwan into the Asia Pacific's premier biomedical and development research hub.

Overall the BIIP consists of four goals, the first being the construction of a biomedical corridor in Taiwan. Our aim is to integrate Taiwan's various innovative clusters, from north to south, into a

single biomedical corridor that stretches the length of the island and includes all facet of the biomedical chain.

The second goal is to upgrade Taiwan's industry infrastructure and ecosystem. We will enhance the efficiency of innovation by building out basic infrastructure and upgrading the biomedical research, development, investment, and marketing ecosystems. In addition, we are striving to strengthen and clarify laws and regulations pertaining to the industry, upgrade Taiwan's talent pool, and bolster capital and other areas to create a positive environment for accelerated growth.

Third, with the BIIP we want to further connect Taiwan with the rest of the world. Our hope is to engage with the world and foster a widespread innovation network by entering international markets, establishing relationships with global research institutes, recruiting international talent, and building advanced R&D centres.

Finally, the last goal is to pursue the industries of the future. Through the BIIP, we will promote key industries and specialty sectors, including welfare for ageing populations, precision medicine, and specialty biomedical solutions. Special emphasis is being put on emerging industries of the future, such as digital health, cell therapy, medical technologies, and precision robotics as well as AI applications.

Regarding the progress of the plan, since 2008, the investment in the biotech industry has been growing steadily. The investment in 2018 reached USD 1.77 billion – the amount of investment was USD 710 million in the pharmaceutical sector, USD 560 million in the medical device sector, and USD 510 million in the applied biotechnology sector. In 2018, there were 113 private investment projects in the biomedical industry, an increase of 15 cases from 2017. In 2018, the revenue of Taiwan's biomedical industry was USD 16.5 billion, with an overall growth of 5.5 percent.

The BIIP is now governed by the Board of Science and Technology of Executive Yuan (BOST), under the supervision of the Minister without Portfolio, DR. Tsung-Tsong Wu. The MOST is responsible for optimization of Taiwan's biomedical industry innovation ecosystem in partnership with other ministers.

As Taiwan currently faces a stage of industry upgrade and transformation, redefining itself from semiconductors, there is a great need to cultivate a new generation of innovative R&D talent. How is the MOST facilitating the collaboration of talent between the public and private sectors?

To narrow the gap between higher education institutions and businesses, the MOST last year launched a three-year program named “Rebuild After PhDs’ Industrial Skill and Expertise” (RAISE), with the aim of sending 1,000 doctorate holders to intern within the industry and to help career positioning or start their own firms. The program participants receive subsidiary support during their one-year internship. This project’s implementation framework and important elements include working with research institutes, university partners, and businesses to provide more than six-month internship opportunities for doctorate holders who are willing to participate in. Following training, they are matched with suitable employment or entrepreneurial development.

MOST encourage our PhD talents to acquire international research/industrial experiences and global vision. We launched the “Learn Explore Aspire and Pioneer Program” (LEAP) that partnered with over 100 international corporations and academic institutes in the US, Israel and France since 2017. The program is anticipated to lift up our talents in strategic thinking and entrepreneurship as well as networking with international resources. MOST also collaborates with Stanford University SPARK program for entrepreneurship training. In fact, Taiwan is the first and one of the most successful global partners of Stanford SPARK program to bring innovation in conjunction with venture capitals and pharmaceuticals in the world. Currently, there are six anchor universities in SPARK Taiwan with more than 200 academic teams resulting in 29 start-up companies, 13 technical transfers and 41 projects entered clinical trials. SPARK Taiwan is also part of the Steering Committee of SPARK Global consisting of 19 countries and over 40 global top research institutes. As the regional leader in SPARK Asia, SPARK Taiwan will hold the SPARK Asia Showcase that brings 12 teams from Singapore, Korea, Taiwan and Australia in Taiwan in 2019. Apart from international collaboration with specific partners, MOST also launched Global Research & Industry Alliance (GLORIA) in universities and formed 18 alliances to date. Through cooperating with domestic and global enterprises thus bridging resources from the industries into academia, GLORIA could cultivate more talents in universities that synchronized to the global trend. In addition, GLORIA also establishes industrial training and talents matchmaking courses to nurture new generation R&D talents for the members’ needs.

Talent recruitment should be global. MOST has launched the “Leaders in Future Trends Program” at the same time in response to the global race for talents recruitment. The 2019 LIFT 2.0 establishes both online/offline platform for active matching of abroad talents with domestic industries, academia, and research institutes and the open job positions. The program subsidizes round trip flight and local living accommodations for the talents to attend a matching event in Taiwan.

In addition, MOST launched a flagship program last year aiming to connect global resources to build a friendly ecosystem for high-tech startups and to foster their entrepreneurship in Taiwan. The “Taiwan Tech Arena” program (TTA) has attracted global and domestic talents and efficiently accelerated innovation toward commercialization by building a co-creation platform for startups, accelerators, venture capital, and corporate partners. Public and private international partners in TTA include French Tech Taiwan, Canadian Technology Accelerator, SparkLabs Taipei, BE Capital, SOSV-MOX and IAPS, etc., just to name a few. More than hundred deep-tech startups were attracted to TTA last year in collaboration with more than 20 corporate partners such as Acer, CTBC Bank, Wistron, ChungHwa Telecom, Microsoft, nVidia, Audi, DBS and etc.

Taiwan is not alone in this endeavour of creating Asia’s leading biotech cluster as we see with the Shenzhen Bio Valley and the Hong Kong Science and Technology Park. What elements will make the corridor successful and what factors are still missing to truly create a supercluster within Taiwan?

Taiwan is renowned for its precision manufacturing and information communication technology (ICT) in the global community, and the government of Taiwan is now turning its sights toward the country’s biomedical industry. Based on our historical success in ICT, we understand that cluster is very important for any industry. We are taking inspiration from the achievements of the Hsinchu Science Park, the Taiwan Silicon Valley, to replicate a similar ecosystem for biomedical industry here in Taiwan. We anticipate the long-term investment in both talent and money capitals as well as effective strategies on this island would produce a solid foundation, with an ecosystem that spans the entire biomedical value chain, to transform Taiwan into a hub of biotech and biomedical R&D in Asia.

The Hsinchu Biomedical Science Park (HBSP) and Jhunan Biotech Industrial Area jointly contribute the “Biotechnology Development Belt” which is beneficial to the formation of an industry cluster. The HBSP acts as a powerhouse for the cultivation of domestic innovation and biomedical industrialization. In addition to general services and infrastructure, the park also provides business planning, rapid prototyping and pilot scale-up design, preclinical validation, clinical trial-related resources, and legal affairs-related services, as well as investment services. The park can significantly reduce R&D cost, increase the success rate of biomedicine related new startups, and promote the business development of the biomedical industry in Taiwan via the business platform, integrated resources, and clinical trial-related resources.

What capabilities does Taiwan have to excel in some of the most innovative sub-sectors of biotechnology such as cell and gene therapies and regenerative medicine?

When it comes to next-generation science, MOST Minister Liang-Gee Chen often said that you should always start with the end in mind. Therefore, we are trying to pursue the future industries by encouraging innovation ideas and bringing new concepts into the biomedical field. This is very important because any innovation we are trying to build is ultimately for the benefit of patients.

All of the new therapies and treatment methods that exist must, of course, pass through a clinical trial, so to facilitate this process the MOST has set up the Taiwan Clinical Trial Consortium (TCTC). Fundamentally, we are looking at Taiwan as a huge hospital so that when PIs want to collect cases, it will be much faster and even more efficient. This will not only benefit Taiwan's clinical trial environment and R&D of these treatments, but it will also benefit the international pharmaceutical and medical device industries.

Additionally, Taiwan's government has already launched the "Regulations Governing the Application of Specific Medical Examination Technique and Medical Device" which was adaptable for six autologous cell therapies, including CD34 selected and CD45RA depleted hematopoietic stem cells, immune cells, adipose stem cells, fibroblasts, mesenchymal stem cells, and chondrocyte transplantation. Nowadays, the 29 clinical trials for cell therapy have been approved by the Food and Drug Administration of Taiwan (TFDA). Possessing advanced regulations and academic researches, together with the global partnership Taiwan's aiming to become one of the leading countries of cell and tissue therapy in the future.

How has the government has been working to combine Taiwan's strength in semiconductor and ICT industries with biomedicine to take advantage of the rapidly growing digital health sector?

Taiwan has selected several key fields in which we can leverage our existing unique advantages to take the lead. Under the guidance of the BIIP, the government is integrating Taiwan's abundant biomedical R&D resources, the competitive advantages of the semiconductor industry, and our ICT manufacturing services. It is expected that there will be more innovation and cross-discipline integration, such as big data and AI applications for better healthcare management and ecosystem, to leverage Taiwan in becoming an innovation hub of digital health in Asia Pacific.

In 2018, Insilico Medicine, one of the global top 100 AI companies, set up their R&D base in Taiwan, to strengthen the deep learning capacity on pharmaceutical chemistry and work with the Development Center for Biotechnology (DCB) to develop new drugs and therapies. This is a good example of how Taiwan's R&D capabilities can contribute to the development of digital health with international cooperation.

Besides, there are several good advances in digital health from our benchmark IT companies in Taiwan. Advantech and Imedtac, to name a few, have utilized their medical resources and IoT technology to provide integrated IT systems and cloud services to hospitals. ASUS Life is partnering with Omni Health to import and integrate ICT to develop a total solution for medical service, hospital management, and health clouds.

To catch the next wave of digital health, the MOST has formulated a general AI development strategy and five action plans in 2017, including Semiconductor Moonshot, Robot Maker Space, and Grand Challenge, to build up the infrastructure and motivate the industry to improve our overall competitiveness in AI. We have the capability of getting ahead of the explosive growth of digital health and its huge potential business opportunities, thus driving the industrial restructuring and upgrading.

There is a high focus on biotech and innovative areas which are not yet making contributions to Taiwan's economy. Where do the traditional companies in pharma and generics, for example, have space in all of this?

These companies need to innovate and maybe make a broader question all together about the role of traditional pharma and what are the steps they can take to reinvent themselves, otherwise, they will always face challenges during the transformation of economy styles and global competitiveness. I believe that all the traditional pharma and healthcare industries can be upgraded in many different aspects including strengthening in house R&D and academia industrial collaborations. The traditional way of drug discovery via high throughput screening could be augmented by novel structural biology tools and advanced AI to accelerate resolving protein structures and in silicon drug design. What used to take up to years can now be accomplished in a matter of weeks or months.

We have built up these capabilities already and Taiwan has its own supercomputing facilities in National Laboratories under MOST. We also initiated the Taiwan Protein Project (TPP) with advanced Cryo-EM facilities in Academia Sinica and the National Cheng Kung University (NCKU) as

well as two synchrotron radiation facilities for more efficient protein structure resolution and identification of promising leads. We have already seen good results from these projects with candidate drugs or vaccines developed.

Through decades of investment in fundamental researches by MOST and further industrial translation, certain new drugs were already approved in Asia, the US, and Europe by Taiwanese pharma. Beside small molecule drugs, companies in Taiwan have also invested significantly in macromolecular therapeutics, advanced formulations, cell therapy and regenerative medicine. Innovations as a company culture would help traditional pharma to survive and prosperous. MOST has established a series of mechanisms to pave the way.

In conclusion, what final message would you like to deliver about the competitiveness of Taiwan's biotechnology industry environment?

We are trying to transform Taiwan's industry from original equipment manufacturing and original design manufacturing towards an innovation and knowledge-driven economy. Looking at the biomedical industry, it has a nature of a lot of knowledge intelligence and Taiwan has the advantage of having a highly educated population and spirit of innovating and entrepreneurship. We encourage our talent to question, to debate and explore new ideas. Taiwan has a strong mixed culture and welcome input from different cultures when looking back to the history of this island. We are eager to engage the world and to make contribution and impact. Taiwan has a friendly society and open innovation environment and we welcome the world to come and collaborate with us.

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